ON THE RECENTLY OBSERVED EVIDENCES OF AN EXTENSIVE GLACIER ACTION AT MOUNT KOSCIUSKO PLATEAU.

By Richard Helms.

(Communicated by Professor T. W. E. David.)

(Plate xviii.)

> "Quod minimum est, minimum est; sed in minimum fidelium esse magnum est."

Whether Australia, or any portion of it, underwent a glacial period has for a number of years been a disputed question among geologists, and up to quite recently the evidences in favour of this conjecture have been so scanty, and were mainly based upon the occurrences of striated or polished (?) rocks, that it cannot be wondered at that the proofs of it were not considered conclusive. If such an astute observer as the late Rev. Tenison-Woods only a few years ago could declare, and probably justly so at the time, that the evidences of a glacial period were not reliable, it is not surprising that the subject remained a doubtful question so long.* It is also very plainly perceptible from the report to the Minister for Mines furnished by Dr. R. v. Lendenfeld after his visit to Mount Kosciusko during the early part of January, 1885,† that he based his suppositions entirely upon the glacier-worn rocks he

* J. E. Tenison-Woods.—"Physical Structure and Geology of Australia," P.L.S.N.S.W. Vol. vii. 1882, p. 382. "There is no satisfactory evidence of any former participation in the great ice age by the Continent of Australia. One or two instances of grooves or striations are recorded, but, standing alone in so vast a territory, the ice origin is very doubtful. On the whole, the evidence afforded by the animal remains is decidedly in favour of a warmer climate for Australia than that which now prevails, and this is borne out by the plant remains."

† Report by Dr. R. von Lendenfeld on the results of his recent examination of the central part of the Australian Alps.

maintained to have discovered near the base of this mountain and some distance further east.*

During my first visit to the Snowy Mountains (Feb., 1889) I carefully looked for striæ and polished surfaces on the rocks described by Dr. v. Lendenfeld, particularly in Wilkinson Valley, but could not agree with him that they retained such traces, although the general appearance when looked at from a distance favoured the theory that glaciers had ground them down, and that some of the valleys had undergone a prolonged glacial action. On none of the many solitary rocks and exposed rock-surfaces (except in one instance that will be referred to below) I examined then and since have I found *polished* surfaces, nor the characteristic striæ seen on most of the reliable *roches moutonnées*. If, however, the nature of the rock formation is taken into consideration, the absence of these features can scarcely be surprising, because its tendency to weather is so great that it forbids one to expect the retention of polish or striation for any length of time. I am of the opinion that, except where buried in moraine deposits, very few polished and striated rock fragments will be discovered in this district. The principal rock of the whole system of the Australian Alps is a gneisic granite, often rather coarsely crystallised and occasionally friable when exposed. This rock changes in many places into true gneiss, splendid illustrations of which are afforded in the beds of nearly all the tributaries of the Snowy River on the high elevations. These rocks occur everywhere on the highest portion of the Snowy Mountains except in one part (between Dividing Peak and Mt. Twynam), where slate overlies the granite and forms several secondary ranges. Neither of these rocks, it will be admitted, is very weather-resisting, nor can they withstand the erosive action of the atmosphere and the severe changes of temperature for a great length of time. In fact, in my opinion, a couple of centuries would almost suffice to completely obliterate all the unmistakable evidences, such as polish and striæ.

* L.c. p. 10. Dr. R. von Lendenfeld says—"I have found no moraines in the district which might indicate that once glaciers existed there, but I have found rocks polished by glacial action in many places."

The only piece of rock I have seen that has retained its polish I found about a mile and a quarter to the north of Mt. Twynam on the southern side of a rugged peak surrounded by a number of rocks of various dimensions. The block is about four feet long and nearly square and lies with its polished surface upwards. About the third of one corner of the surface has split off and shows no polish, but the remainder is polished perfectly level, but still shows a number of shallow pits where the polish did not reach the original fracture-surface. The rock of this piece is a very quartzose granite (syenite ?) quite dissimilar from the prevailing rock, and evidently much harder, which accounts for the retention of the polish. There are, however, no striæ noticeable, which is rather remarkable, as they are generally present on glacier-polished surfaces. The beautifully striated and polished specimens of quartzite from the head of St. Vincent Gulf I saw in the possession of Prof. Ralph Tate at the University of Adelaide are without doubt most characteristic examples of glaciated rocks, and surpass all that have so far been found in the Australian Alps.

To what erroneous conclusions careless and superficial observations may lead one I have had the opportunity of judging during my recent visit to these mountains.*

Dr. R. v. Lendenfeld in "The Glacial Period of Australia"† says: "Further proofs for the correctness of the supposition that we have to do with the effects of ice are furnished by the relative position of joints and surface. The polishing goes on of course quite regardless of joints, and consequently in ninety-nine cases out of a hundred one will find the polished surface cutting the joints at varying angles, and not parallel to the direction of any joints."

This very feasible-looking supposition is, however, entirely inapplicable to the rocks of the Australian Alps, where I found a number of recent fractures going crosswise in almost every direction imaginable to the joints, which, surprising as it is, seems

* February, 1893.

† P.L.S.N.S.W. x. p. 48.

almost as frequent as the splitting with the joints. The pieces so split, moreover, show generally a very even surface, which adds to the appearance as if they had been ground level. One cannot, however, mistake such fractures if they are carefully examined. Besides, very frequently both planes are found in close proximity, and being still free from any growth of lichens it proves their recent separation. The most remarkable boulder met with by me may be described as follows. The two faces of it are perfectly level and meet at an angle of about 140° and therefore cross the same joints in two directions. On first approaching this remarkable specimen I felt delighted, thinking that I had met with a unique glaciated block; when, however, on close examination, I could not discover any traces of polish or striæ I came to the conclusion that the shape of the boulder was attributable rather to extraordinary fractures than to glaciation. I am the more inclined to this belief because the specimen is comparatively rich in quartz, and therefore should have resisted erosion better than many of the other boulders met everywhere.*

So much for the glacier-polished rocks, which are certainly extremely rare in these regions. However, in the light of evidence I am able to bring forward, it is quite justifiable to assume that many of the rounded, concave, and level surfaces found upon a number of the large rock-facings have been produced by glacier action, *although the minute features of it* have long since been destroyed by erosion and decomposition.

From the discovery by me of a number of terminal moraines it can no longer be doubted that during a certain period the whole of the Kosciusko Plateau† was covered with ice, and that the little differences in height at present found between the valleys and most of the ranges are to a great extent due to the levelling action of glaciers.

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* The block lies some distance up the south-eastern side of the "Dividing Peak."

† In the strict sense of the word this term is perhaps not applicable, but I have adopted it for convenience' sake. It is a gradually rising highland, with mostly gently sloping and low ranges.

Many of the valleys are flat at the bottom and filled with rock débris, which is exposed to observation wherever a watercourse passes through them. Extensive flats occur in places, with large rocks sticking out of the surface here and there and bogs all over them. These flats have all been formed by ice, and the bogs in them are the result of deficient drainage owing to the blocking of the natural incline by remnants of terminal moraines. Some of these terminal moraines are well-defined, and the packing of the boulders near them frequently plainly visible. All the moraines observed by me end towards the east or south-east; at any rate it is plainly demonstrable that the ice moved from a westerly direction. It is reasonable to presume that in former ages as now the westerly winds predominated in these regions, and probably were the strongest as well. In consequence of this, great masses of fallen snow would be blown in an easterly direction and heaped up on the eastern slopes of the ranges, where the greater accumulation of it would be the means of forming more massive, and consequently longer lasting, glaciers than on the western slopes.

To the west of the Snowy Mountains the valleys are very deep and the ranges much steeper than on the eastern side; on account of this it may be more difficult to trace the glacier action in that direction, nor may they ever have assumed here such proportions as on the other side. There is, however, plenty of scope to discover evidences particularly at the lower end of Wilkinson Valley and to the south-west of Mount Townsend, as well as near the lakes to the south of it.

It appears that the ice-streams taking an easterly direction precipitated into the Crackenback Valley at almost every break in the Ramshead Range, and wherever this took place terminal moraines more or less distinct are to be found. Such at least is the aspect of it as presented to the observer at the present time, which almost leaves the impression of the glaciation having been confined to the highest portion of the ranges. It was not possible for me to visit all these interesting spots, but a great number I have more or less closely examined, and with the help of the

accompanying map (Pl. XVIII.) I shall be enabled to point out and describe some of the most interesting and conspicuous features of glaciation that have come under my observation.

After crossing the Crackenback River a short distance above its junction with the Snowy River the track begins to lead steadily upwards till it reaches the foot of a mountain spur. The ascent of this is steep in many places and the top of it about 4500 feet above sea-level. From here the ascent becomes again more gradual, and continuing for about a mile Wilson Valley is reached, and an open grassy flat shows up to the right. This may safely be considered attributable to glacier action, and probably a few smaller flats met with previously owe their origin to the same cause. Above this flat the valley narrows considerably between the steep ranges on both sides for some distance, when it again widens out. Here terrace-like several boulder packings cross it at intervals, through which the descending rivulet is seeking its course in a sinuous line. Ascending further the valley expands into a large flat that faces the eye with a distinct terminal moraine, the fan-like expansions of which slope down the valley. Entering the flat we stand on Boggy Plain and upon an unmistakable glacier deposit, that covers with all its ramifications more than a square mile at an elevation of about 5200 feet above the sea. Surrounded by elevated ground, and on account of its raised termination towards Wilson's Valley this plain is in many places very boggy, which is a characteristic feature of nearly all the plains and flat valleys among these ranges, and has been alluded to above.

Proceeding onward, the evidences of ice-action become more plentiful at almost every turn, and scarcely a valley is crossed that does not testify to this formation. Very pronounced it appears again on the flat about a quarter of a mile from Pretty Point. This flat is strewn with boulders partly embedded in the smaller débris of various kinds of rock and gritty soil, and ends, in an easterly direction, towards the Crackenback River, with a fan-like expansion down the side of its valley.

Just below the rise that leads to Pretty Point a small flat occurs similar in nature to the last described, ending also, in a southerly direction, at the margin of the Crackenback Valley, near the place where it makes a turn. In this locality enormous blocks of granite have been pushed over the declivity. One of these erratics, weighing several hundred tons, rests on divers others high enough from the ground to allow a man to pass underneath. These characteristics leave the impression as if at one time the ice had passed over the short range that runs north-westwards from Pretty Point.

The height of Pretty Point close by is about 5780 feet above the sea, and from here the ground has a gentle slope of about half a mile to the west as far as Thompson Plain, which, extending for about a mile in a S.E. to N.W. direction, expands to a third of a mile in width. This portion of the "plateau," which has now been reached, is very interesting regarding its glacification, for here evidently a large portion of the leading ice-stream pushed its way in a southerly direction, splitting, so to say, against the north-western portion of the spur that branches off from the short range at Pretty Point. At the south-eastern end of this branch, where it precipitates over the declivity of the Crackenback Valley, a vast bedding of boulders has been formed, the remarkably close packing of which reminded me of the pack-ice when a block occurs during the ice-flow in the northern European rivers. At the northern end of this branch probably the largest of any of the flat valleys found on the "plateau" runs east and westerly for nearly two and a half miles, and at one time no doubt carried one of the most continuous ice-streams that stretched across the valley to the north of Pretty Point as far as the Crackenback, as well as in the direction of Boggy Plain and Wilson Valley. Not far from the junction of Thompson Plain and higher up, particularly on its northern side, various massive granite facings bear still the marks of the gouging action of the ice in their concaved and deflexed surfaces, which are otherwise, however, much eroded.

Prior to the time when the bifurcation took place the glacier must have been considerably more massive and undoubtedly swept over the rise at Pretty Point. This is plainly demonstrated by the features met to the east and south-east of this elevation, and has been already referred to. The interest involved in this is that the ice-cap of the plateau must have been so enormous that its limit could not well be brought within its confines, but must have extended over a far greater area, for which, however, I am not at present in a position to bring forward positive proof.

All other features and indications met with on the plateau could well be explained as having originated from local glaciation.

The terminal moraines formed as the glaciers gradually receded to the highest elevation will no doubt be met with in many more localities than I was able to visit during my short stay in the mountains. Those seen by me are marked on the map and need no further description, excepting those I found close to one of the highest peaks, which surpass all others in their perfect preservation and unique formation.

At the base of Mt. Twynam and in the valley to the south of the Crummer Range, between this and the branch range that runs out from the slate cap in an easterly direction towards the Snowy River, these distinct and unmistakable evidences of glacier action have been preserved. It seems almost as if the configurations of the neighbouring mountains and ridges had been specially designed for the purpose of retaining these evidences, and probably no other locality in any part of the world can be found where within so limited a space such a number of various evidences testify to the former existence of ice, and prove the wonderful changes it has made on the face of the earth.

The small snow-fields hanging on the ledges and in the clefts of the south-eastern declivities of Mt. Twynam faintly indicate still how ages ago the snow piled up here and, transformed into masses of solid ice, worked its way downward. This snow at the present day never entirely disappears, and, though it only granulates and is no longer transformed into ice, may be regarded as the last remnant of former glacier formation. The pure liquid oozing

out from under it flows down the sides and ledges of the rocks and leaps in numerous waterfalls over a surface that for many thousand years did not see daylight, when it was covered by a massive layer of ice. At the foot of the range the water feeds a lake,* that now reflects the azure of the sky, but darkened with greater intensity on account of its depth, having its placid surface exposed to the gay sunlight that for eons of time was hidden in darkness by the rigid cover that slid high above it slowly into the valley below. It remained a solid block of ice long after the sliding glaciers had ceased passing over it, and their abrading action stopped depositing the débris below and around it. Thus it rested; but now this eye in the Alpine landscape does not always reproduce the surrounding cliffs on a smooth surface. The waterfowl disporting themselves upon it sometimes ripple the water, and when the searching gales which frequently sweep the neighbouring heights reach this sheltered position it may even be agitated into waves.

To the south-east of this lake an extraordinary and almost unique feature is met with, of which but few similar and none else so perfect exist.

The peculiar formation cannot be better described than by calling it a moraine-dam, because it resembles an artificially heaped up railway embankment more than anything else I know of. Running in an almost E.N.E. and W.S.W. direction, it extends for about a third of a mile in a straight line, with even scarps on both sides, and has a flat top, which is about half a chain wide. At its eastern side it leans against a granite outcrop, and towards the west it finishes with a spreading talus just as if truck loads of stuff had been tipped over in that direction. It is in places upwards of a hundred feet higher than the valley it forms with the adjoining secondary and portion of the Main Range, and is entirely composed of granite and slate fragments mixed with earth.

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* Lake Merewether. Named by me in honour of the worthy president of the N S.W. branch of the R. Geog. Soc.

How this extraordinary feature was formed and placed in such a remarkable position—for it forms, so to say, a ridge in the centre of a valley—is a very perplexing question to answer. After carefully scrutinising its surroundings, however, I have formulated a theory which I think will explain its origin.

The granite outcrop at its eastern end played no doubt an important part towards its origination. I presume that when the glacier field became reduced to glacier streams, and these so far receded that they only filled the valleys, and the deposition of débris began within their limits, was the time when this strange moraine-dam started to form. The glacier coming over the top of Mt. Twynam down the valley was evidently jammed by the granite outcrop and piled up between this protrusion and the southern branch of the Crummer Range.* Thus blocked, the ice-current must have progressed rather slower at the base than on top when this portion passed over the obstructing granite protrusion. The upper stratum of the ice, although following on the whole the general direction of the lower one, would naturally expand in a lateral direction, where it was not impeded, and constantly crumbling away and likely dropping down some distance, it must have deposited the débris of rock it carried with it in this marvellously evenly shaped configuration. Whilst I see things seemingly clearly enough in my mind's eye, and can picture to myself the locality and its environs, I must admit that it baffles me to offer in words the graphic delineation that is necessary to correctly impart my meaning. I hope, however, that at least to some extent I have been lucid enough to convey an idea of this marvel.†

* Named by me in honour of my friend Mr. H. S. W. Crummer, the worthy and indefatigable treasurer of Royal Geog. Soc. in Sydney.

† Two more such singularly formed moraine-dams were observed by me, but none of them can be compared as to the regularity of their shapes to the one near Lake Merewether. One of these is situated at the southern side of the low saddle in the Main Range, not far from the "Dividing Peak," and the other can be found near the lower side of the Etheridge Range (named after Robert Etheridge, jun., Palæontologist), a secondary range that runs almost parallel to the Main Range near Mt. Townsend. Both places are marked on the map.

Not more than a few hundred yards below the eastern end of this moraine-dam a moraine of the general type expands over the whole width of the valley and fills it to nearly where it is crossed by the Snowy River. Rising crescent-shaped, with an even sweep and moderately declining talus upwards of twenty to twenty-five feet above the valley, it is about a quarter of a mile wide and probably half a mile long. Heavy granite boulders of all sizes lie piled up together, intermixed in places with some of slate. Irregularly deposited as they are, they form a more or less evenly directed incline, with some of the largest rock masses protruding above it. The whole spreads in the distinctive fan-like shape and diverging ridges, and wedges out at the lower end. Low shrub vegetation covers it here and there, particularly at the upper end and where the interstices are filled up ; grass hides the stones, but a great many patches are still nude and probably have not altered much in appearance since first the rubble was left there, except perhaps that weathering has rounded the surfaces of the boulders, which is specially noticeable with the slate fragments. A shallow lake at its upper end has found an outlet through these rubble masses and discharges its water meanderingly through them into the infant waves of the Snowy River below. This lake is not above a few feet deep in the centre, and its origin is simply the effect of the moraine below it having dammed the valley ; consequently it was the result of ice action, but in a different way from that in which Lake Merewether was formed.

My examinations can by no means be considered exhaustive even as far as the plateau is concerned, and no doubt many more interesting features are likely to be found upon it. Besides that, there is nearly the whole of the western side of the Main Range and its extent as far as Kiandra (nearly 50 miles), so to say, scientifically unexplored, and offering an extensive field for further investigation. No doubt at the western side of the highest peaks the most favourable locality exists for new discoveries. The only moraine deposit I have examined on the western side is the small peninsula that almost divides Lake Albina. This lake owes its

origin mainly to the fact that the valley below it has been filled to some extent with rock fragments and large blocks, probably brought there through the action of glacier currents, but the declivities of the enclosing ranges are steep enough to allow the deposition to be attributed to landslips. However, ice-action has originated the moraine in the lake, and therefore the filling of the valley is likely, to some extent at any rate, due to the same cause.

Into the very height of summer some snow-fields remain on the eastern side of the Main Range, and a few never entirely disappear. The general extent of the deposits is indicated by the total absence of all vegetation, and their area is therefore easily traced by a fringe of verdure. Most of them disappear rapidly towards the end of February, and those that do not vanish entirely are by that time reduced to their minimum extent. It depends both upon the greater or lesser quantity of snow-drifts during the winter as well as upon the higher or lower average temperature whether these snow-fields disappear earlier or later. Those nestling on the precipitous declivities below the peaks of Mt. Kosciusko and Mt. Twynam are perhaps the only ones that never entirely disappear even in the hottest summers, and it may safely be said that they remain permanent over a limited area. The conditions are most favourable for the retention of snow in these places, the elevation for one thing, as well as the fact that the rugged peaks furnish many clefts for the accumulation of it and that the spots are only touched by the solar rays during the early part of the day when they do not furnish much heat, combine to prevent as rapid a melting in these places as elsewhere.

During my late visit I found snow in many more places remaining at the end of February than I noticed on my previous visit in 1889. This must be entirely attributable to the prevailing cool weather during the last summer, because I was informed that the snow-fall had been much lighter than usual during the preceding winter.* This year the winter set in very early on these heights. Already the middle of February began to get

* There was even snow left in the shaded clefts just above Lake Merewether between 600 and 700 feet below the summit of Mt. Twynam.

cold. At an elevation of 5500 feet near Pretty Point my min. therm. registered: Feb. 20, 31° F.; Feb. 21, 26°; Feb. 22, 33·5°; and the max. therm. 45·5°, 54°, and 53° respectively on those dates. Although this cold wave was replaced again by warmer weather for a few days, the temperature soon went down again, and winter, it may be said, had begun to set in. This is rather an exceptionally early time for it; as a rule the weather remains mild till the middle of March.

In connection with the snow-fields I am able to record the interesting occurrence of "red snow," which, as far as I am aware, has previously not been observed in the southern hemisphere, certainly not in Australia.

On nearly all the patches of snow I visited a large portion of their surface was noticed to be of a dirty red colour. The dirty appearance was caused by dust, as generally is found upon melting snow, but the red on examination proved to be a minute alga that singly has an intense colour like dark blood. Whether it is identical with the *Protococcus nivalis* of the Arctic regions I am unfortunately unable to prove, because I could not preserve the organisms for microscopic examination, but if not identical it is likely that the Australian plant is closely allied to it. That, however, the colouring matter is an alga and not caused by any other substance the simple lens sufficiently attests. These algæ live most luxuriantly and very abundantly a few inches below the surface, and when the dirty granulated crust of the snow is removed to the depth of an inch or two the sight is surprising and pleasing. The disclosed part reveals a beautifully fresh crimson colouring speckled with pure white snow granules, that resembles the hue of a freshly cut ripe watermelon.

These observations, that were made by me whilst staying but a short period in the Australian Alps, during which time the fogs and the rainy weather frequently prevented my leaving the camp, I wish only to be considered as a record of such, and regret that my limited experience and insufficient knowledge of geology prevent me to attach a speculative opinion to them regarding the age during which the glaciation of these mountains occurred.

From what I have seen I must confess that it appears as if this region underwent a glacier period within its own limits and that the cessation of it dates not very far back. The evidences are very striking and abundant, and considering the perfect boundary of the moraines near the base of Mt. Twynam, extensively described above and carefully delineated upon the map, it is my opinion that here the last of the glaciers existed, when the ice-cap that probably covered the whole area of the plateau became separated into independent ice-streams. If Australia participated in a great southern glaciation, to which opinions, after other recent discoveries, seem to tend more than ever, it is but natural that the highest parts of it should have retained the ice longest, and considering that even now the summer heat is not sufficient to remove all the accumulating snow completely, the reduction of the glaciers must have been extraordinarily slow, although the highest peaks of the Snowy Mountains rise but little over 7000 feet above the sea.

What surprises me not a little is the fact that several eminent men who visited these mountains, and passed almost over exactly the same track as I did, should have overlooked the proofs that lay so manifestly plain below their feet. The many doubts that had been thrown upon the probability of glacier traces existing in Australia, together with the positive assertion by one geologist that he had not found any moraines, whilst he must have walked over nearly a dozen of them, prevented me from making some of the statements contained in this paper known four years ago, after my first visit to Mt. Kosciusko. I was always desirous to revisit these localities to convince myself of the correctness of the opinion formed at that time, which recently I have more than fully accomplished.

The occurrence of gold at the bottom of the glacier deposits on the eastern end of the plateau and beyond it is noteworthy. Fairly payable patches were found along Piper's Creek and Digger's Creek. At both these places a few parties were working still, and during the last ten years some miners have from time to time worked in these localities. At Boggy Plain a party was prospecting during my last stay, and had obtained particles

of gold in several holes they had sunk. But the gold is everywhere very thinly distributed and at the best "patchy"; no defined leads have been found, which from the nature of the deposit could scarcely be expected. From one of the miners, who had worked for several years at Kiandra, I heard that the gold-washes in that district were similar to those at Digger's Creek, at the upper end of which he was working at the time of my visit. If this information is correct it is probable that the Kiandra gold-field may have received its gold through ice-formation as well; this would form an interesting subject for closer investigation.

I have alluded to a probability of a greater extension of the glaciation than most of the described evidences indicate, for the proof of which I can, however, not bring forward any distinct evidences. The indication that, prior to the division of the ice-stream which filled to some extent the valleys to the west of Pretty Point, a larger glacier passed over the height of this place has already been noticed, and I now will briefly refer to what seems to me furthermore corroborative of this opinion.

To the south of the upper Crackenback River is a plain called the "Big Boggy Plain," and to the west of the Eucumbine River the "Snowy Plain" is situated; both are at an elevated position. Although I had no opportunity to visit these localities, from the description I have received of the character of the plains there is no doubt left in my mind that they owe their origin to ice-formation.

A very suggestive place I crossed on horseback is the "Rocky Plain" at the upper watershed of the Eucumbine. This is nearly 4000 feet above sea-level, and was, it is likely, formed by ice-action, and much of its surrounding country and its neighbouring levelled portions tend to confirm this hypothesis.

There are, however, indications observable at a lower level (but still about 3000 feet above the sea), which on closer examination may prove to be evidences of glaciation. These I simply passed over or by, during my coaching trips in the Monaro district, and

therefore merely record them, without being able to comment upon their more minute nature.

The localities I allude to are: the grassy flats of the Mowamba Valley; the plain near Berridale*; the flats near Adaminaby, more particularly when the road from Cooma is taken, *viâ* Middlingbank; and in several places on the road from Cooma to Bombala, *viâ* Nimitybelle.

The Monaro district is to a great extent undulating country, traversed by several of the more prominent offshoots of the Australian Alps, and abounding everywhere in more or less extensive plains. On many of these lakes are found of various dimensions, mostly of a circular shape, the larger of which carry water permanently, whilst the smaller generally dry up during protracted rainless seasons.

Although time did not permit me to make closer observations, from what I saw during my flying passage over the places mentioned I was much impressed with their appearance, and the opinion gained ground in me that some of the features noticed might be the means of proving a more extensive glaciation than undoubtedly existed on the Kosciusko Plateau.

Regarding certain names on the highest ranges some differences exist between the geographers that first named the heights, &c., and the application of these names by later visitors. To obviate further mistakes I have attached the initials of the authorities to the names on the map: a new departure in map-making, but necessitated on account of the existing confusion.

* A remarkable conglomerate formation occurs in a place near the Cooma-Berridale road not far from a lake, which, like all the other features, received only a passing glance from me.